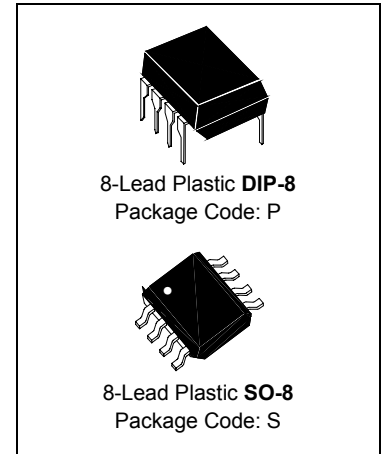


AX3842P / AX3842S

High Performance Current Mode Pwm Controlers

Description

The AX3842 Series is high performance fixed frequency current mode controllers. That is specifically designed for Off-Line and DC To DC converter applications offering the designer a costeffective solution with minimal external components. These integrated circuits feature a trimmed oscillator for precise duty cycle control. A temperature compensated reference, high gain error amplifier, current sensing comparator, and a high current totem pole output ideally suited for driving a power MOSFET. Also included are protective features consisting of input and reference undervoltage lockouts each with hysteresis, cycle-by-cycle current limiting, programmable output deadtime, and a latch for single pulse metering.



Features

- Trimmed Oscillator for Precise Frequency Control
- Oscillator Frequency Guaranteed at 250 kHz
- Current Mode Operation to 500 kHz
- Automatic Feed Forward Compensation
- Latching PWM for Cycle-By-Cycle Current Limiting
- Internally Trimmed Reference with Undervoltage Lockout
- High Current Totem Pole Output
- Undervoltage Lockout with Hysteresis
- Low Startup and Operating Current

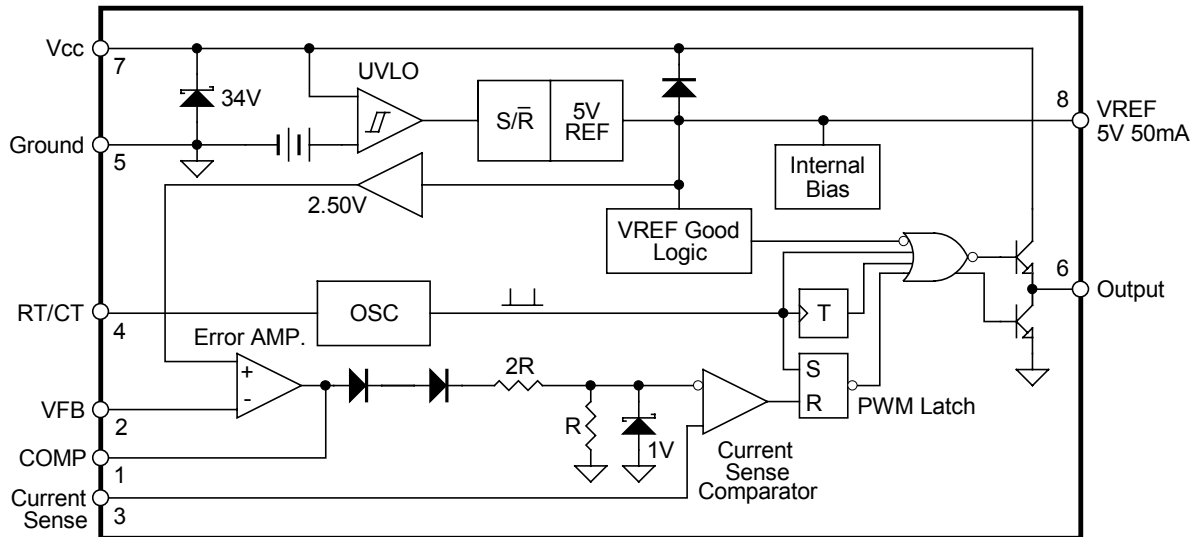
Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_i	Supply Voltage (low impedance source)	30	V
V_i	Supply Voltage ($I_i < 30\text{mA}$)	Self Limiting	
I_o	Output Current	± 1	A
E_o	Output Energy (capacitive load)	5	μJ
	Analog Inputs (pin 2, 3)	-0.3 to 5.5	V
	Error Amplifier Output Sink Current	10	mA
P_{tot}	Power Dissipation at $T_{amb} \leq 25^\circ\text{C}$	800	mW
T_{stg}	Storage Temperature Range	-65 to 150	$^\circ\text{C}$
T_j	Junction Operating Temperature	-40 to 150	$^\circ\text{C}$
T_L	Lead Temperature (soldering 10s)	300	$^\circ\text{C}$

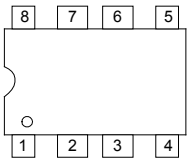
Thermal Data

Symbol	Description	DIP-8	SO-8	Units
$R_{th\ j-amb}$	Thermal Resistance Junction-ambient	100	150	$^\circ\text{C/W}$

Block Diagram



Pin Connection (Top View)

Package	Function	Description
 <p>DIP-8</p> <p>SO-8</p>	Pin1: Compensation	This pin is the Error Amplifier output and is made available for loop compensation.
	Pin2: Voltage Feedback	This is the inverting input of the Error Amplifier. It's normally connected to the switching power supply output through a resistor divider.
	Pin3: Current Sense	A voltage proportional to inductor current is connected to this input. The PWM uses this information to terminate the output switch conduction.
	Pin4: RT/CT	The oscillator frequency and maximum output duty cycle are programmed by connecting resistor RT to Vref and capacitor CT to ground. Operation to 500kHz is possible.
	Pin5: Ground	This pin is the combined control circuitry and power ground.
	Pin6: Output	This output directly drives the gate of a power MOSFET. Peak currents up to 1A are sourced and sunk by this pin.
	Pin7: Vcc	This pin is the positive supply of the control IC.
	Pin8: Vref	This is the reference output. It provides charging current for capacitor CT through resistor RT.

Electrical Characteristics

Unless otherwise stated, specifications apply for $0 \leq T_{amb} \leq 70^\circ\text{C}$ $V_{CC}=15\text{V}$ (Note 1);

$R_T=680\Omega$, $C_T=0.022\mu\text{F}$ for triangular mode, $R_T=10\text{k}$, $C_T=3.3\text{nf}$ for sawtooth mode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Reference Section						
V_{REF}	Reference Output Voltage	$T_J=25^\circ\text{C}$, $I_o=1\text{mA}$	4.90	5	5.1	V
ΔV_{REF}	Line Regulation	$12\text{V} \leq V_{in} \leq 25\text{V}$	-	2.0	20	mV
ΔV_{REF}	Load Regulation	$1\text{mA} \leq I_o \leq 20\text{mA}$	-	3.0	25	mV
$\Delta V_{REF}/\Delta T$	Temperature Stability	(Note 2)	-	0.2	-	mV/ $^\circ\text{C}$
	Total Output Variation	Line, Load, Temp (Note 2)	4.82	-	5.18	V
e_N	Output Noise Voltage	$10\text{Hz} \leq f \leq 10\text{kHz}$, $T_J=25^\circ\text{C}$ (Note 2)	-	50	-	μV
	Long Term Stability	$T_a=125^\circ\text{C}$, 1000Hrs (Note 2)	-	5	-	mV
I_{SC}	Output Short Current	$T_a=25^\circ\text{C}$	-30	-100	-180	mA
Oscillator Section						
f_{OSC}	Frequency	$T_J=25^\circ\text{C}$	47	52	57	KHz
		$T_{low} \leq T_A \leq T_{high}$	46	52	60	KHz
$\Delta f_{OSC}/\Delta V$	Frequency Change with Volt.	$12\text{V} \leq V_{CC} \leq 25\text{V}$	-	0.2	1	%
$\Delta f_{OSC}/\Delta T$	Frequency Change with Temp.	$T_{low} \leq T_A \leq T_{high}$ (Note 2)	-	5	-	%
		$T_J=25^\circ\text{C}$	-	0.5	-	%
V_{OSC}	Oscillator Voltage Swing	Peak to Peak	-	1.7	-	V
I_{dischg}	Discharge Current ($V_{OSC}=2\text{V}$)	$T_J=25^\circ\text{C}$	7.8	8.3	9.3	mA
		$T_{low} \leq T_A \leq T_{high}$	7.2	-	9.5	mA
Error Amplifier Section						
V_2	Voltage Feedback Input	$V_O=2.5\text{V}$	2.42	2.50	2.58	V
I_b	Input Bias Current	$V_{FB}=5.0\text{V}$	-	-0.1	-2.0	μA
A_{VOL}	Open Loop Voltage Gain	$2 \leq V_O \leq 4\text{V}$	65	90	-	dB
BW	Unity Gain Bandwidth	$T_J=25^\circ\text{C}$ (Note 2)	0.7	1.0	-	MHz
PSRR	Power Supply Rejection Ratio	$12\text{V} \leq V_{CC} \leq 25\text{V}$	60	70	-	dB
I_o	Output Current	Sink ($V_O=1.1\text{V}$, $V_{FB}=2.7\text{V}$)	2.0	12	-	mA
		Source ($V_O=5.0\text{V}$, $V_{FB}=2.3\text{V}$)	-0.5	-1.0	-	mA
$V_{OUT-High}$	Output Voltage Swing High State	$V_{FB}=2.3\text{V}$, $R_L=15\text{K}$ to ground	5	6	-	V
$V_{OUT-Low}$	Output Voltage Swing Low State	$V_{FB}=2.7\text{V}$, $R_L=15\text{K}$ to V_{REF}	-	0.7	1.1	V
Current Sense Section						
G_V	Current Sense Input Voltage Gain	(Notes 3 & 4)	2.85	3.0	3.15	V/V
V_3	Maximum Input Signal	$V_{PIN1}=5\text{V}$ (Note 3)	0.9	1.0	1.1	V
SVR	Supply Voltage Rejection Ratio	$12\text{V} \leq V_{CC} \leq 25\text{V}$ (Note 3)	-	70	-	dB
I_b	Input Bias Current		-	-2.0	-10	μA
	Propagation Delay	$T_J=25^\circ\text{C}$ (Note 2)	-	150	300	nS

Electrical Characteristics (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<i>Output Section</i>						
V _{OL}	Output Voltage (Low State)	I _{sink} =20mA	-	0.1	0.4	V
		I _{sink} =200mA	-	1.5	2.2	V
V _{OH}	Output Voltage (High State)	I _{source} =20mA	13	13.5	-	V
		I _{source} =200mA	12	13.4	-	V
V _{OLS}	Output Voltage with UVLO Activated	V _{CC} =6V, I _{sink} =1mA	-	-0.1	-1.1	V
t _r	Output Voltage Rise Time	T _J =25°C, C _L =1.0nF (Note 2)	-	50	150	nS
t _f	Output Voltage Fall Time	T _J =25°C, C _L =1.0nF (Note 2)	-	50	150	nS
<i>Under-Voltage Lockout Section</i>						
	Start Threshold		14.5	16	17.5	V
	Min. Operating Voltage	After Turn On	8.5	10	11.5	V
<i>PWM Section</i>						
DC _{max}	Maximum Duty Cycle		94	96	-	%
DC _{min}	Minimum Duty Cycle		-	-	0	%
<i>Total Device</i>						
I _{st}	Start-Up Current		-	0.1	0.5	mA
I _i	Operating Supply Current	V _{pin2} =V _{pin3} =0, R _T =10K, C _T =3.3nF	-	11	17	mA
V _{iz}	V _{CC} Zener Voltage	I _{CC} =25 mA	-	34	-	V

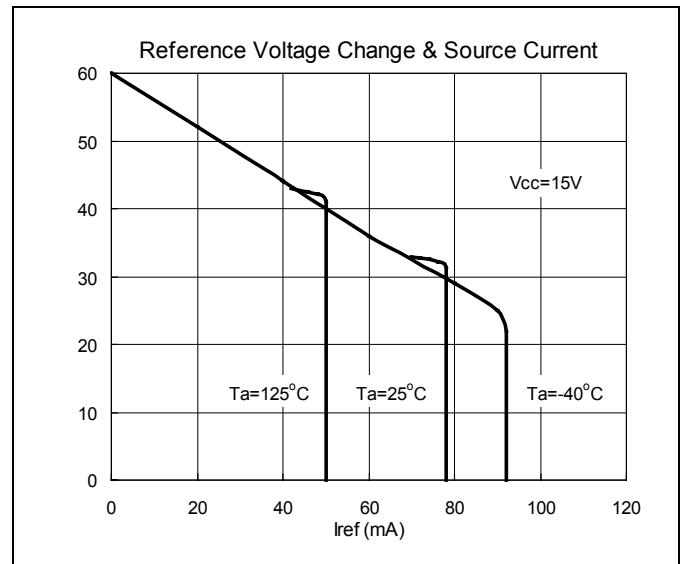
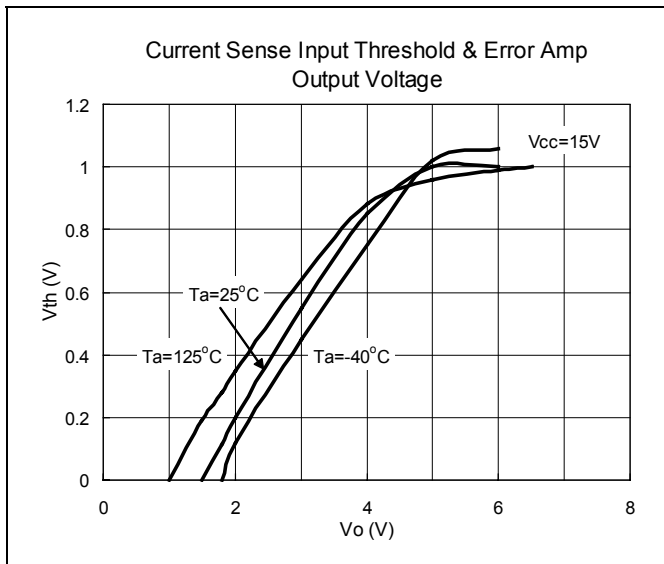
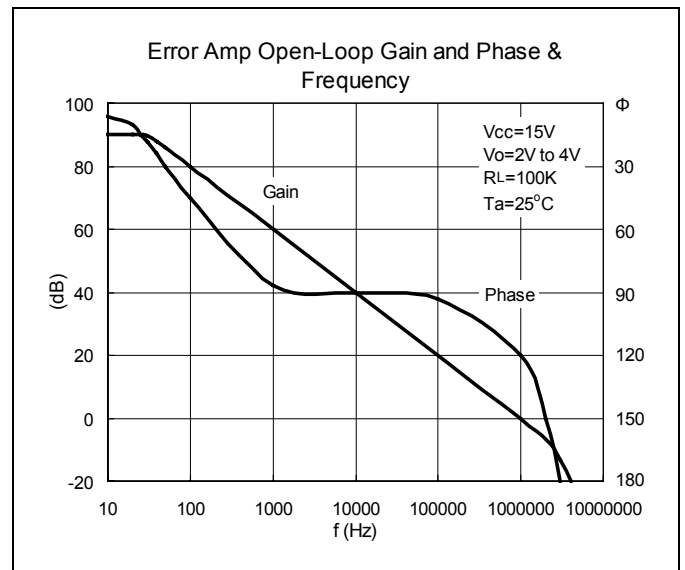
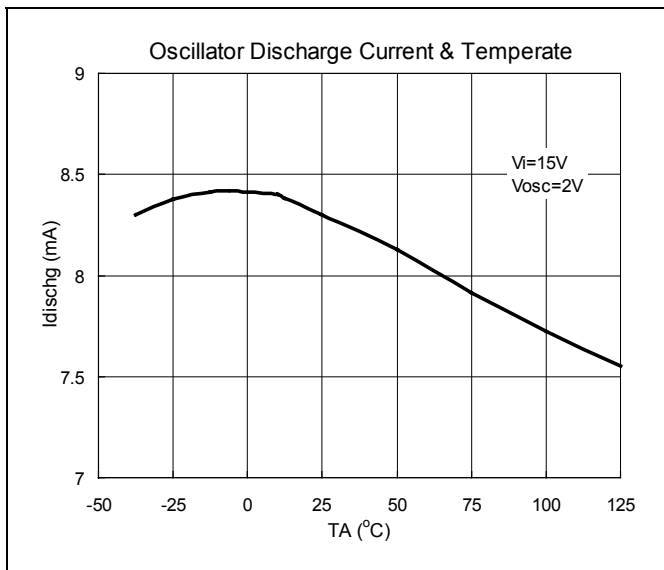
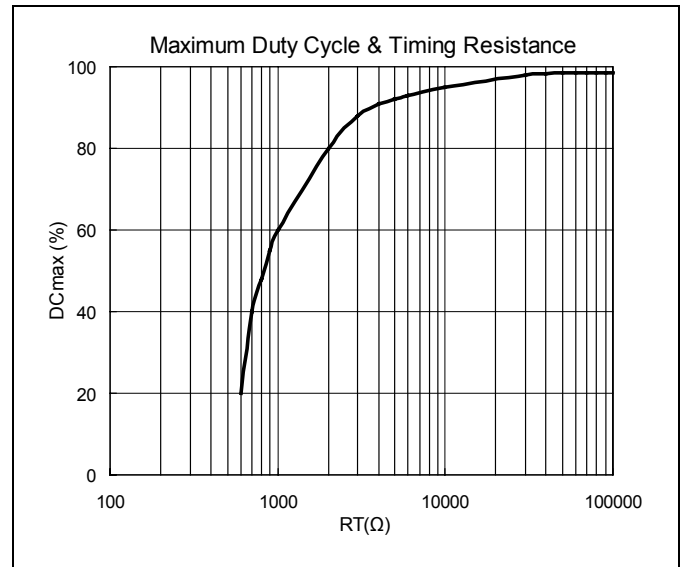
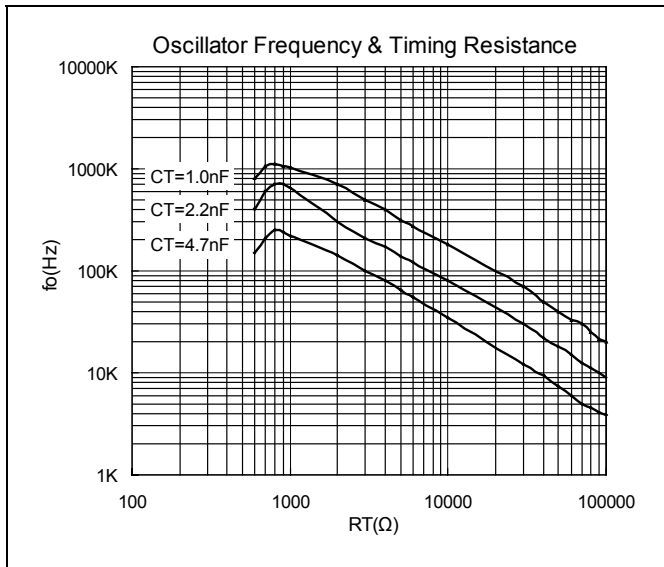
Note 1: Adjust V_{CC} above the start threshold before setting at 15V.

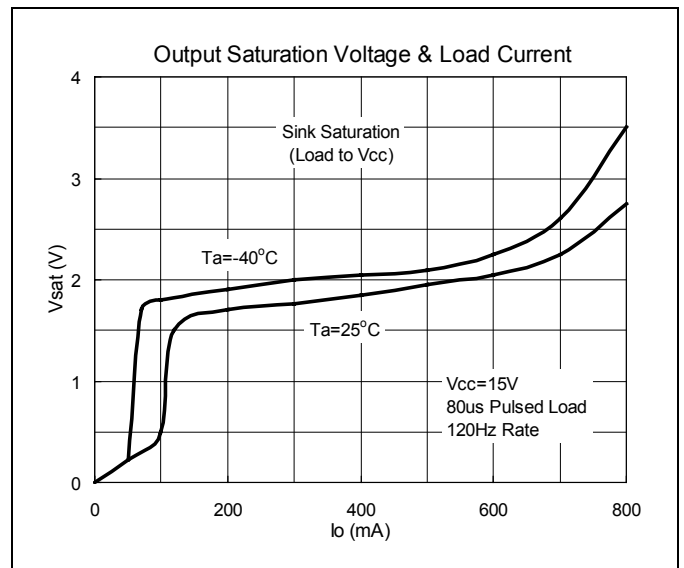
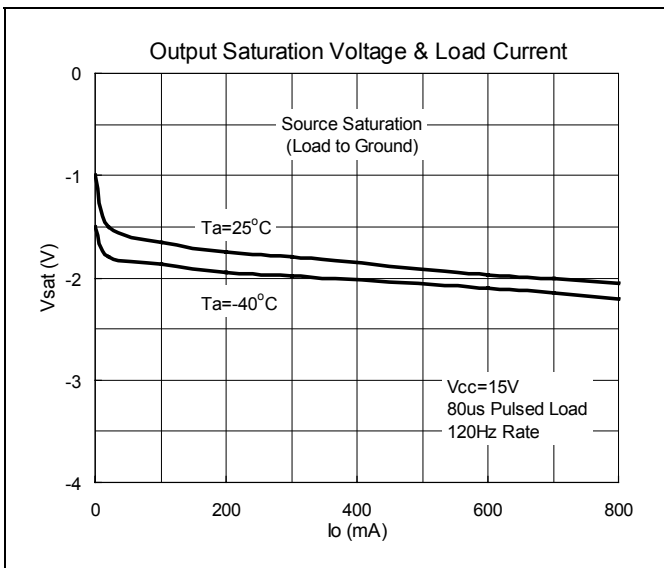
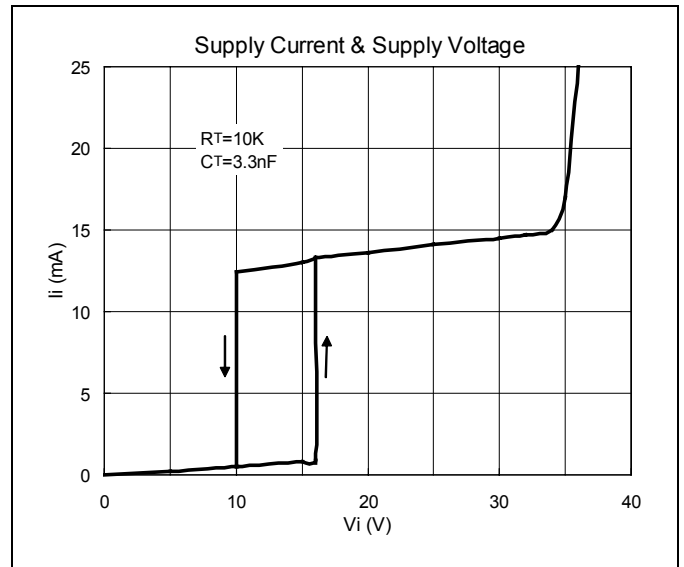
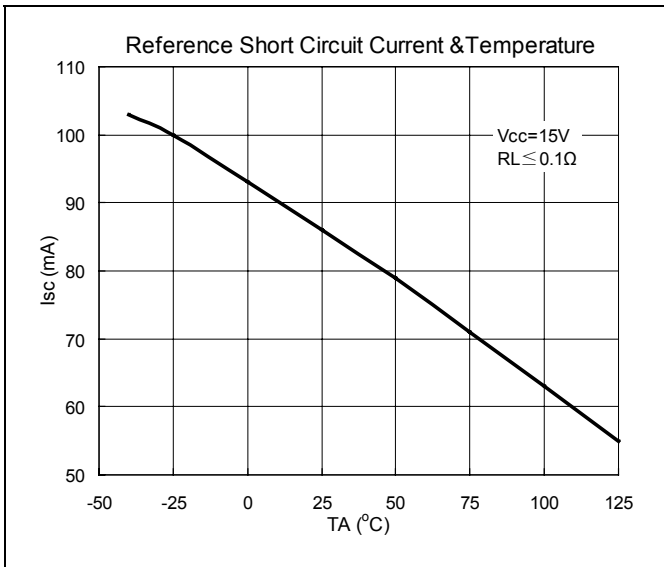
Note 2: These parameters, although guaranteed are not 100% tested in production.

Note 3: Parameter measured at trip point of latch with V_{pin2}=0.

Note 4: Gain defined as: $A = V_{pin1}/V_{pin3}$, $0 \leq V_{pin3} \leq 0.8V$

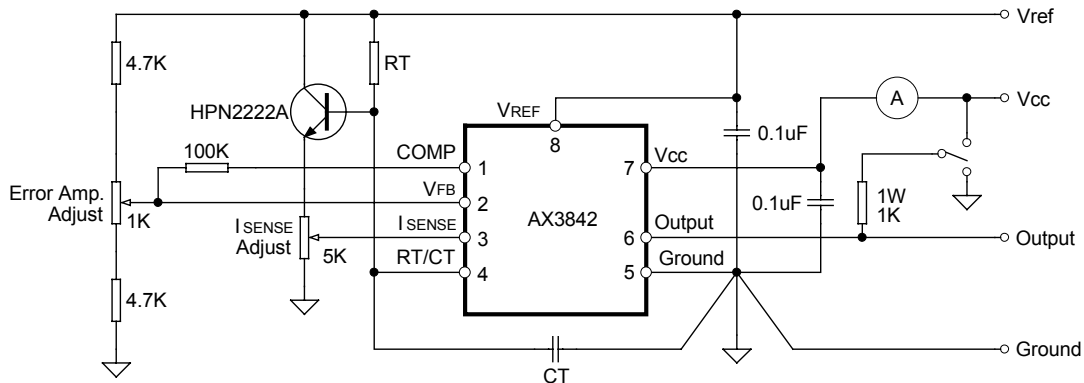
Characteristics Curve





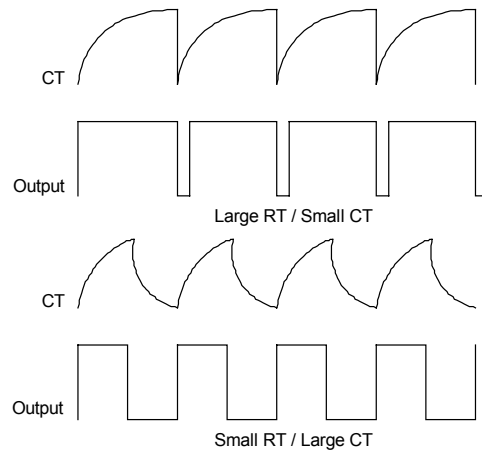
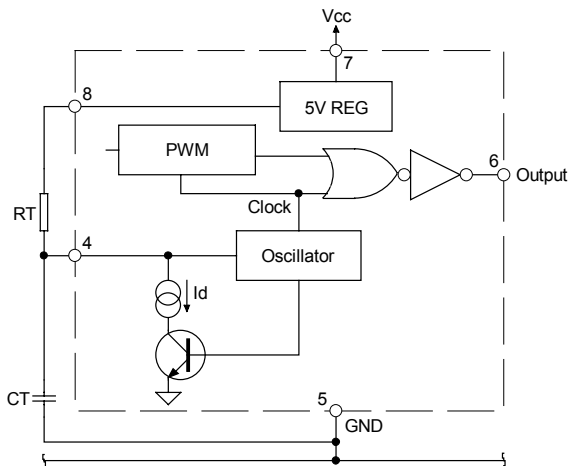
Application Information

Open Loop Test Circuit

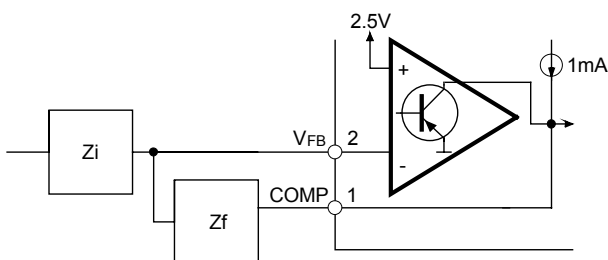


High peak currents associated with capacitive loads necessitate careful grounding techniques. Timing and bypass capacitors should be connected close to pin5 in a single point ground. The transistor and 5K Ω potentiometer are used to sample the oscillator waveform and apply an adjustable ramp to pin3.

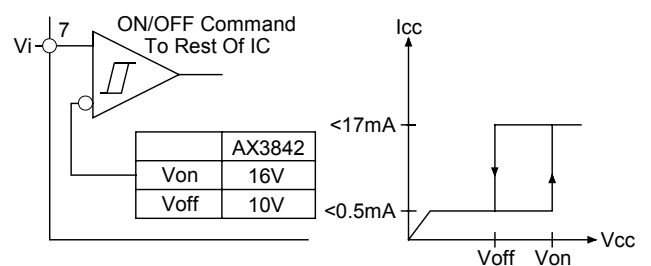
Oscillator and Output Waveforms



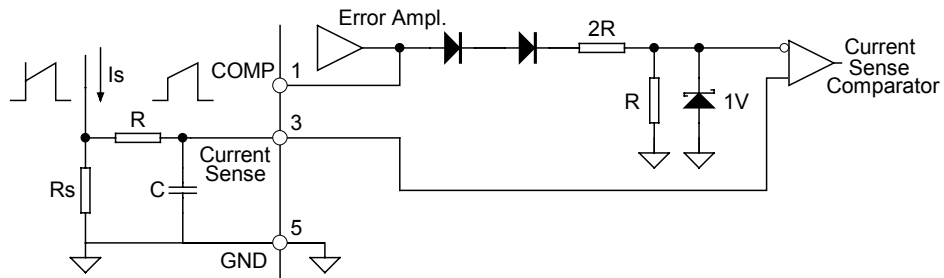
Error Amp Configuration



Under Voltage Lockout

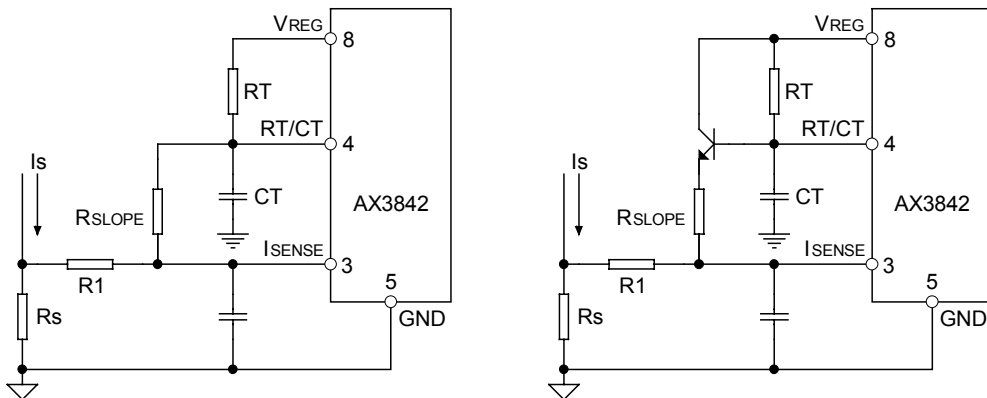


Current Sense Circuit

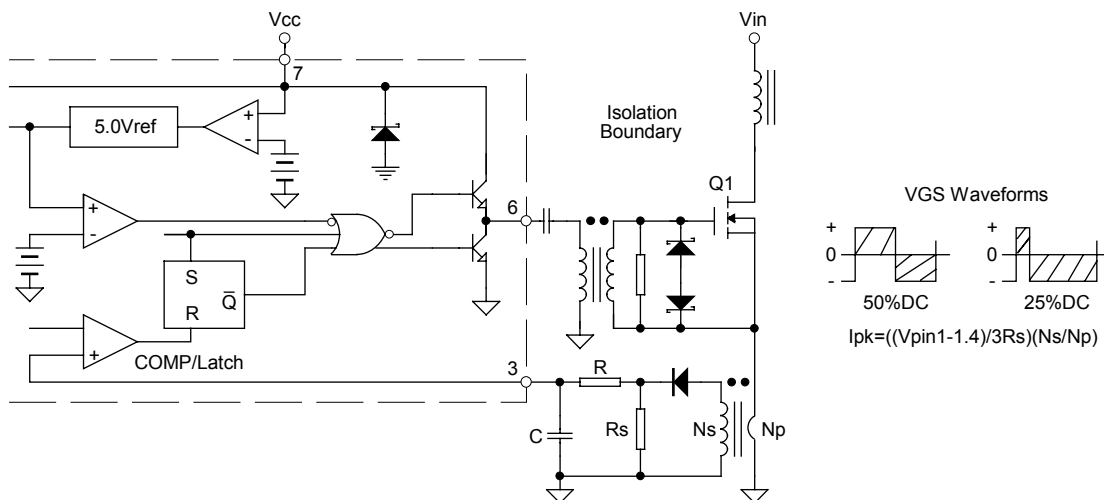


Peak current (I_s) is determined by the formula
 $I_s(\text{max.}) \approx 1V/R_s$
 A small RC filter may be required to suppress switch transients.

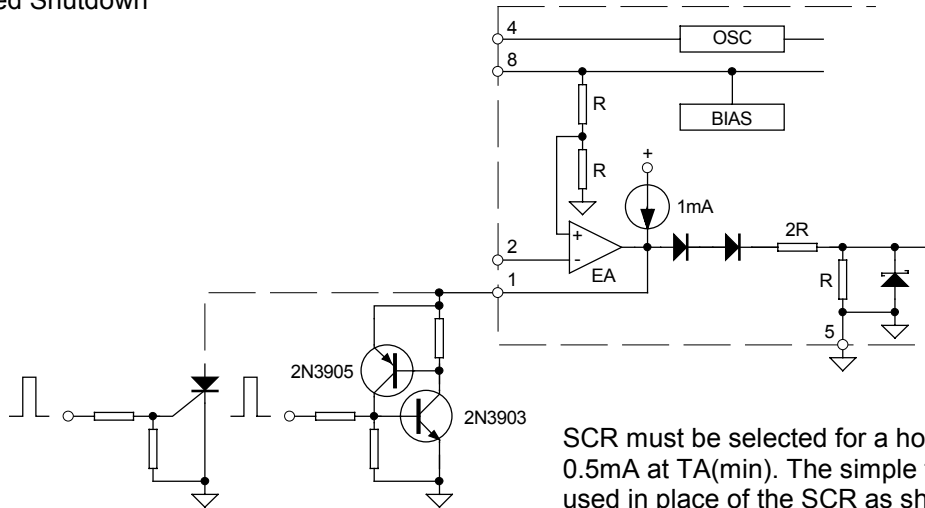
Slope Compensation Techniques



Isolated MOSFET Drive and Current Transformer Sensing

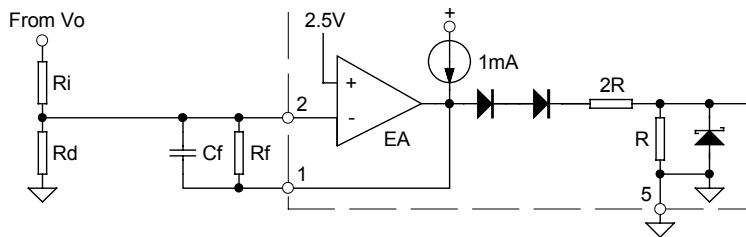


Latched Shutdown

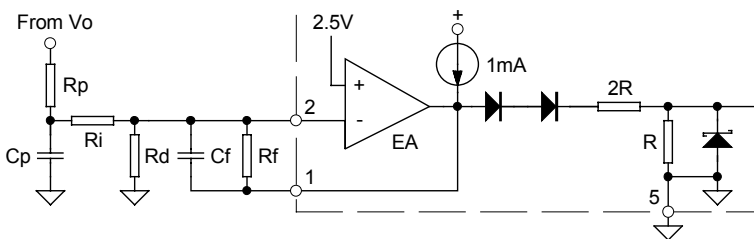


SCR must be selected for a holding current of less than 0.5mA at TA(min). The simple two transistor circuit can be used in place of the SCR as shown. All resistors are 10K.

Error Amplifier Compensation

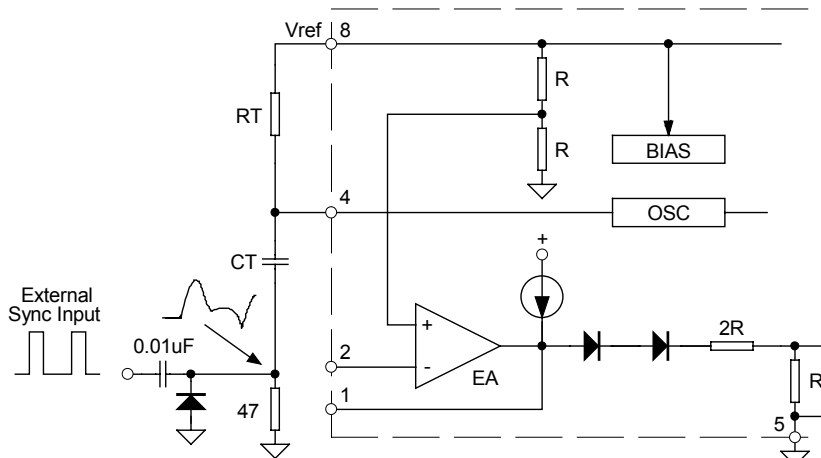


Error Amp compensation circuit for stabilizing any current-mode topology except for boost and flyback converters operating with continuous inductor current



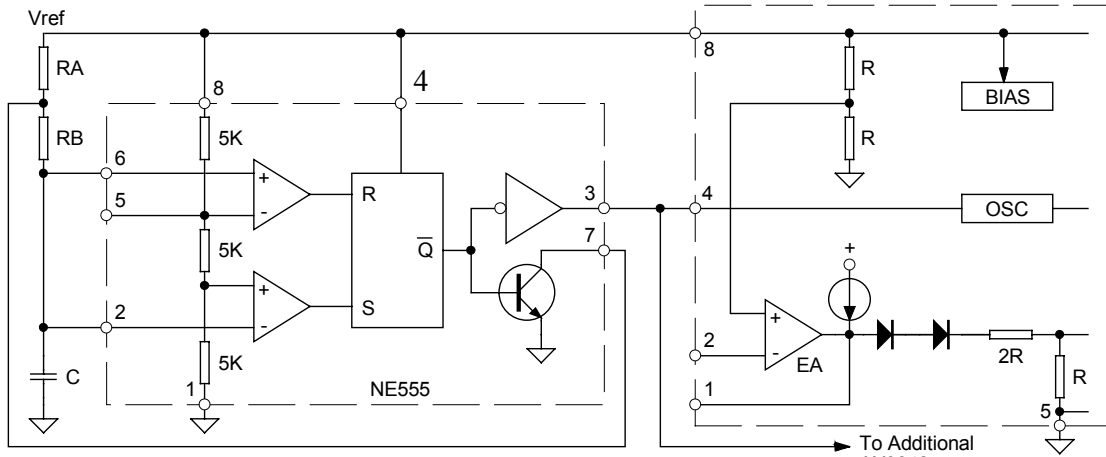
Error Amp compensation circuit for stabilizing current-mode boost and flyback topologies operating with continuous inductor current.

External Clock Synchronization



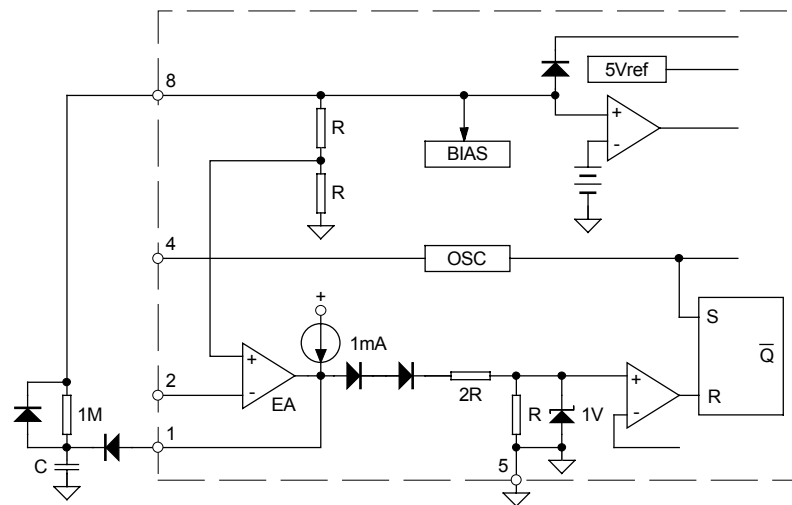
The diode clamp is required if the Sync amplitude is large enough to cause the bottom side of CT to go more than 300mV below ground

External Duty Cycle Clamp and Multi Unit Synchronization

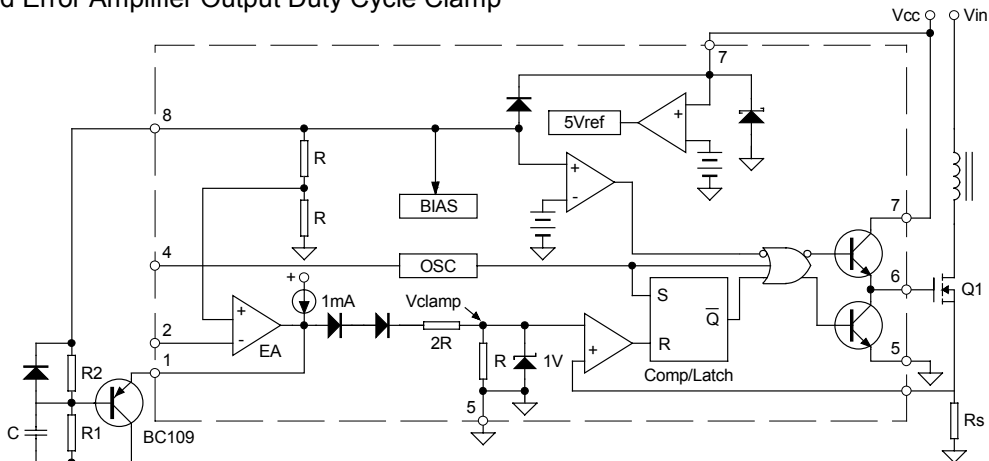


$$f = 1.44 / ((RA + 2RB)C), D_{max} = RB / (RA + 2RB)$$

Soft-Start Circuit

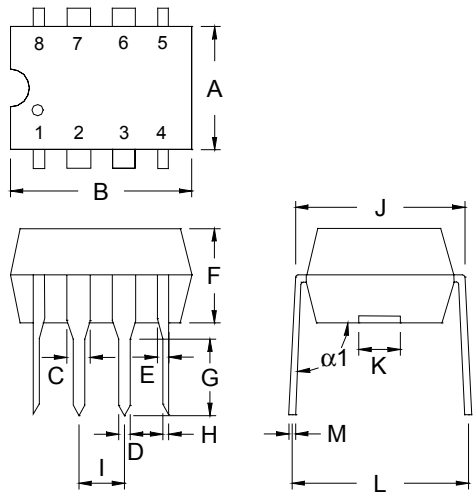


Soft-Start and Error Amplifier Output Duty Cycle Clamp



$$V_{clamp} = R1 / (R1 + R2) \text{ where } 0 < V_{clamp} < 1V, I_{pk(max)} = V_{clamp} / R_S$$

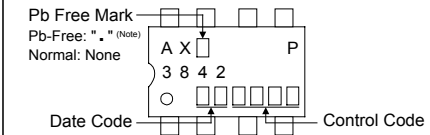
DIP-8 Dimension



8-Lead DIP-8 Plastic Package
AVANTICS Package Code: P

Marking:

Pb Free Mark
Pb-Free: " " (Note)
Normal: None



Date Code Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.COMP 2.V_{FB} 3.I_{SENSE} 4.R_T/C_T
5.GND 6.Output 7.V_I 8.V_{REF}

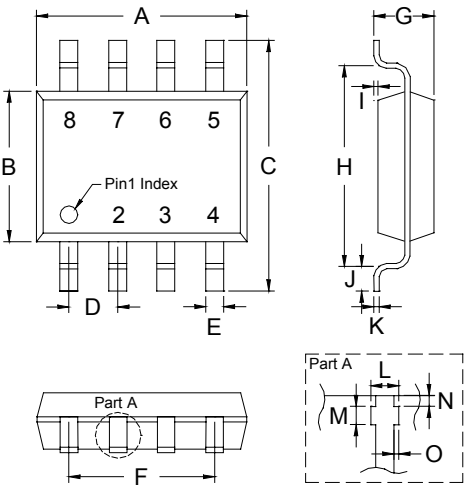
Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	6.29	6.40
B	9.22	9.32
C	-	*1.52
D	-	*1.27
E	-	*0.99
F	3.25	3.35
G	3.17	3.55
H	0.38	0.53
I	2.28	2.79
J	7.49	7.74
K	-	*3.00
L	8.56	8.81
M	0.229	0.381
α1	94°	97°

*: Typical, Unit: mm

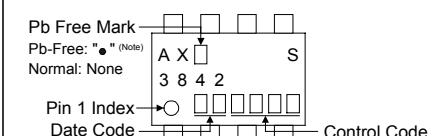
SO-8 Dimension



8-Lead SO-8 Plastic Surface Mounted Package
AVANTICS Package Code: S

Marking:

Pb Free Mark
Pb-Free: "•" (Note)
Normal: None



Pin 1 Index
Date Code Control Code

Note: Green label is used for pb-free packing

Pin Style: 1.COMP 2.V_{FB} 3.I_{SENSE} 4.R_T/C_T
5.GND 6.Output 7.V_I 8.V_{REF}

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	4.85	5.10
B	3.85	3.95
C	5.80	6.20
D	1.22	1.32
E	0.37	0.47
F	3.74	3.88
G	1.45	1.65
H	4.80	5.10
I	0.05	0.20
J	0.30	0.70
K	0.19	0.25
L	0.37	0.52
M	0.23	0.28
N	0.08	0.13
O	0.00	0.15

*: Typical, Unit: mm

Important Notice:

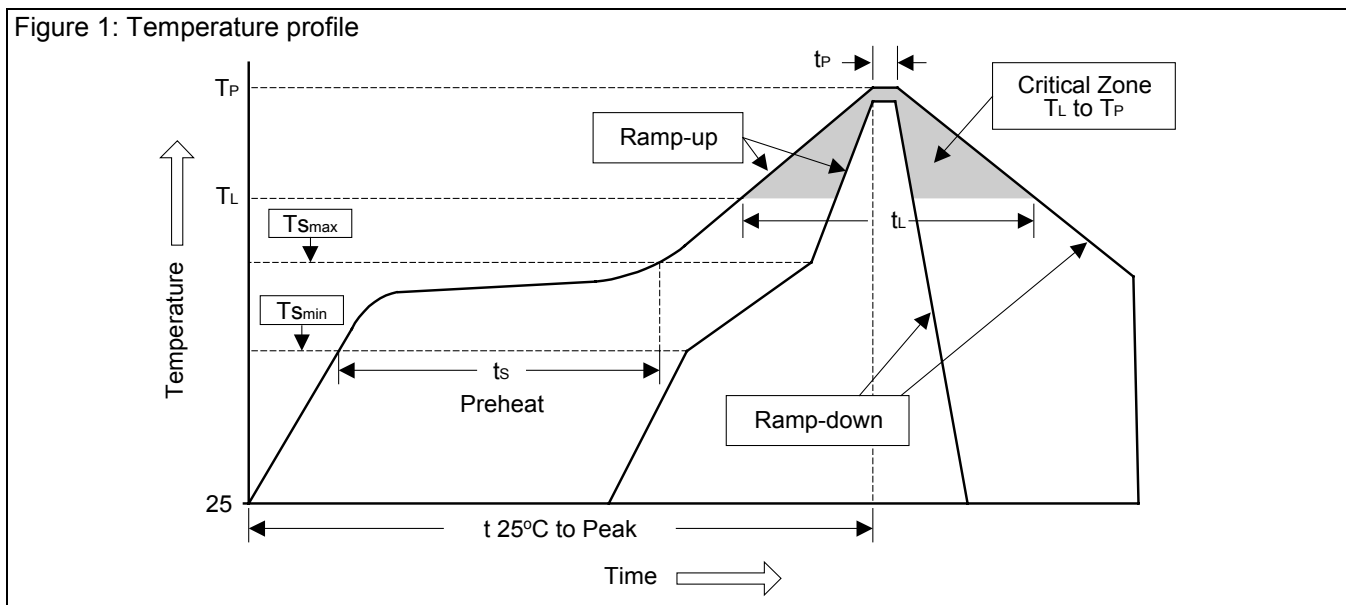
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Tel: 86-021-58955599 Fax: 86-021-58558038

Soldering Methods for AVANTICS's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (T_{smin})	100°C	150°C
- Temperature Max (T_{smax})	150°C	200°C
- Time (min to max) (t_s)	60~120 sec	60~180 sec
T_{smax} to T_L		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (T_L)	183°C	217°C
- Time (t_L)	60~150 sec	60~150 sec
Peak Temperature (T_P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t_p)	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec